Memorandum

To: Accuracy Working Group List (see attached list)

From: Mike Paglione, *FAA ACT-250*

Date: 2/1/2002

Re: **Analysis of User Request Evaluation Tool Daily Use System Aircraft to Airspace Predictions for Inter-facility Accuracy Runs, Revision A[1]**

Scope

For the formal User Request Evaluation Tool Core Capability Limited Deployment (URET CCLD) accuracy testing, aircraft to airspace conflict prediction accuracy requirement values (i.e. CIA1061 through CIA1066) were originally refreshed using actual track based aircraft to airspace encounters, URET Daily Use trajectory accuracy statistics, and an analytical model developed by Duane Ball at Advanced System Technologies, Inc. The verification of the results of this process was determined using the more complex aircraft to aircraft processing. As part of the Risk Reduction Task, the ACT-250 Conflict Probe Assessment Team (CPAT) has developed a set of software tools to directly measure the missed and false alert rates of the URET Daily Use aircraft to airspace conflict predictions. This is analogous to what MITRE CAASD developed to measure the aircraft to aircraft conflict predictions for the specification refresh. The tools are also planned to provide accuracy information for these predictions for the various Risk Reductions Scenarios planned for late FY01 and FY02.

In June 2001, ACT-250 reported on the missed and false alert rates of aircraft to airspace conflict predictions, using only the locally adapted special use airspaces. ACT-250 CPAT adjusted URET Daily Use's operating parameters, so all adapted special use airspaces would be considered active throughout the scenario. Next, URET DU was run in single site mode under Memphis Center's adaptation for May 26, 1999. This corresponds to the first formal accuracy scenario, referred to as 1100_1600. The preliminary study provided an initial view of the direct measurement performance of URET Daily Use aircraft to airspace conflict predictions for the first accuracy scenario, 1100_1600. In August 2001, a final study was completed on the 1100_1600 scenario and then at Lockheed Martin's request expanded to include the remaining five Final Delivery Scenarios. This final study provided aircraft to airspace conflict prediction analysis on both the locally adapted and test special use airspaces. The test special use airspaces were supplied as Government Furnished Property (GFP) by ACT-250 and are incorporated in the formal URET CCLD Accuracy Test.

For the final study in August 2001, MITRE CAASD built a special May 20, 1999 adaptation to include these test special use airspaces for running URET DU. Like the preliminary study, all the

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[1]An error in ACT-250's alert processing program was corrected. This version of the memorandum has revised the original 10/22/01 results, which had incorrectly discarded false alerts. Therefore, the false alert counts have increased and the discard counts have changed.

special use airspaces were considered active for the entire scenario and the nominal URET DU look ahead time parameters were used (i.e. 40 minutes). Therefore, this final study provided a complete view of the URET Daily Use's accuracy performance for aircraft to airspace conflict prediction accuracy requirements.

Run in October 2001 and now revised in February 2002, ACT-250 has completed a follow-up study for the aircraft to airspace conflict predictions for the inter-facility (IFA) accuracy scenarios. This study includes both the current and trial plan accuracy runs. The study will support the specification refresh for the URET CCLD Inter-Facility Formal Accuracy Test, namely the aircraft to airspace conflict prediction requirements CIA1061 through CIA1066 and CIA1068 through CIA1073.

Results

Table 1 and Table 4 provide the counts of the various alert records, conflicts, and missed alert probability for each scenario for the current and trial plan runs, respectively. The airspace conflicts are currently defined as penetrations of the buffered boundaries of the locally adapted and test special use airspaces from the aircraft post processed track positions. Vertically a distance of 500 feet below flight level 290 and 1000 feet above is included as part of the buffered boundaries of the special use airspaces. Horizontally the buffered boundary of the special use airspaces are defined by URET Daily Use adaptation for the locally adapted airspaces and no distance is added to the test special use airspaces. Table 1 and 4 also contains an average column for all six scenarios. Therefore, from Table 1 and 4 the average missed alert probabilities are 0.022 and 0.021 from all six current plan scenarios for the current and trial plan runs, respectively. These missed alert probabilities correspond to the current and trial plan requirements CIA1066 and CIA1073, respectively.

As defined by the URET CCLD specification, the probability of false alerts is a function of the number of false alerts divided by the number of non-conflict encounters within certain ranges of minimum horizontal separations. These non-conflict encounters have separations up to 30 nautical miles from the buffered boundaries of the special use airspace (SUA) horizontally and 4000 feet below flight level 290 and 5000 feet above vertically. For false alerts with encounters beyond these thresholds both horizontally and vertically, the counts fall into the largest false alert bin. For retracted false alerts, which match a particular conflict, the minimum horizontal separation is assumed zero, so these cases are tallied in the smallest bin. Tables 2a-f and the Tables 5a-f contain the encounter counts, false alert counts and false alert probabilities per requirement bin for each scenario. Table 2g and 5g contain the average false alert probabilities for all six scenarios partitioned by requirement bin for the current and trial plan runs, respectively.

An additional outcome of the study was the twelve specific reasons for the various aircraft to airspace accounting of the missed, false, valid, and discarded conflict predictions. Table 3 and 6 describe the various reasons and lists the counts for each scenario. For example, the Table 3 row labeled NO_CALL_MA is an aircraft to airspace conflict that was not notified at all by URET Daily Use and contributed to 36 of the 48 total missed alerts for the 1100_1600 scenario current plan run. URET Daily Use did present notifications for the remaining 12 missed alerts but not within the required 5 minutes of the actual conflict start time. In this case, the 12 missed alerts are found in the next row in Table 3, labeled LATE_MA.

<u>Conclusion</u>

This study provides the reader with direct measurement performance of URET Daily Use aircraft to airspace conflict predictions for all six inter-facility accuracy scenarios. This was performed for both the current and trial plan runs. Both the SUAs locally adapted by URET DU for ZME in the May 20, 1999 chart cycle and the test SUAs are being applied in this study. All the SUAs remain active for the duration of the runs.

The IFA average missed alert probability for the current and trial plan runs of 0.022 and 0.021, respectively, is significantly less than the single site runs of 0.033[2]. ACT-250 believes the advanced warning and communication with the adjacent URET facility result in the improvement. In this case, it was communication between ZME and ZID URET DU systems. Similar improvement is also present in the false alert statistics.

Another observation was the difference between the current and trial plan runs. Unlike URET CCLD, which will expand preferential routing of flights during the trial plan runs, the URET DU trial plan runs are equivalent to the current plan version. The only difference for URET DU is in the analysis of the missed alerts and the bin sizes for the false alerts. The adherence age requirement is increased from 13 minutes for the current plan runs to 20 minutes for the trial plan runs. This will potentially allow more missed alerts to be discarded in the trial plan runs as compared to the current plan runs. This is exactly what occurred for the first four runs and last two had no change. In other words, for URET DU the missed alert performance was slightly improved for the trial plan runs, but there was absolutely no difference in the false alert results, except the change due to the bin sizes.

This study completes the analysis of aircraft to airspace conflict predictions for the inter-facility accuracy runs of URET Daily Use.

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[2] Refer to Memorandum by Mike Paglione, FAA ACT-250, "Final Scenario Risk Reduction Analysis on Aircraft to Airspace Predictions," 8/30/01

Table 1: IFA Current Plan Runs Alert and Conflict Record Counts

Description	SCENARI0						Average
	1100_1600	1200_1700	1300_1800	1400_1900	1500_2000	1600_2100	
Total Alert Records	42026	41602	43298	41439	42410	45718	42749
Total Notification Sets	5912	6060	6364	6199	6300	6808	6274
Total Number of MAs	48	53	52	54	43	46	49
Total Number of FAs	379	355	400	398	441	507	413
Total Number of VAs	2193	2154	2245	2178	2152	2338	2210
Total Number of Discards	3348	3558	3719	3626	3704	3965	3653
Total Number of Encounters (not conflicts)	4403	4386	4639	4587	4686	5120	4637
Total Number of Conflicts (C)	2259	2225	2310	2248	2210	2401	2276
Missed Alert Probability = #MA/(#MA+#VA)	0.0214	0.0240	0.0226	0.0242	0.0196	0.0193	0.022

Table 2a: IFA Current Plan Runs 1100_1600 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 7	1319	310	0.235
7 >= X < 9	241	10	0.041
9 >= X < 11	215	8	0.037
11 >= X < 16	571	16	0.028
16 >= X	2057	35	0.017
Subtotals	4403	379	

Table 2b: IFA Current Plan Runs 1200_1700 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 7	1328	293	0.221
7 >= X < 9	245	10	0.041
9 >= X < 11	199	6	0.030
11 >= X < 16	563	10	0.018
16 >= X	2051	36	0.018
Subtotals	4386	355	

Table 2c: IFA Current Plan Runs 1300_1800 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 7	1431	336	0.235
7 >= X < 9	273	10	0.037
9 >= X < 11	230	7	0.030
11 >= X < 16	587	9	0.015
16 >= X	2118	38	0.018
Subtotals	4639	400	

Table 2d: IFA Current Plan Runs 1400_1900 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 7	1487	341	0.229
7 >= X < 9	261	13	0.050
9 >= X < 11	228	4	0.018
11 >= X < 16	569	9	0.016
16 >= X	2042	31	0.015
Subtotals	4587	398	

Table 2e: IFA Current Plan Runs 1500_2000 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 7	1475	371	0.252
7 >= X < 9	290	19	0.066
9 >= X < 11	238	9	0.038
11 >= X < 16	607	11	0.018
16 >= X	2076	31	0.015
Subtotals	4686	441	

Table 2f: IFA Current Plan Runs 1600_2100 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 7	1602	421	0.263
7 >= X < 9	300	17	0.057
9 >= X < 11	296	13	0.044
11 >= X < 16	672	14	0.021
16 >= X	2250	42	0.019
Subtotals	5120	507	

Table 2g: IFA Current Plan Runs Average Study False Alert Probabilities
(i.e. CIA1061 - CIA1065)

FA Bin	Prob(FA)
0 >= X < 7	0.239
7 >= X < 9	0.048
9 >= X < 11	0.033
11 >= X < 16	0.019
16 >= X	0.017

Table 3: IFA Current Plan Runs Aircraft to Airspace Conflict Prediction Accuracy Counts

Code	1100_1600	1200_1700	1300_1800	1400_1900	1500_2000	1600_2100	Alert Type	Reason Description
STD_VA	2013	1966	2053	1969	1966	2147	VA	Standard valid alert
LATE_VA	180	188	192	209	186	191	VA	Late valid alert, valid since conflict was a popup
NO_CALL_MA	36	44	38	42	28	32	MA	No call missed alert
LATE_MA	12	9	14	12	15	14	MA	Late missed alert
NO_CALL_DISCARD	17	15	13	14	12	15	DISCARD	No call discarded since out of adherence
LATE_DISCARD	1	3	0	2	3	2	DISCARD	Late discard since out of adherence
NO_TRK_FA_DISCARD	2564	2764	2900	2800	2834	3035	DISCARD	No post processed track a predicted conflict start time so discard
NO_ADHER_FA_DISCARD	153	166	173	210	223	251	DISCARD	Out of adherence at predicted conflict start time so discard
CLR_FA_DISCARD	154	162	168	144	148	151	DISCARD	Retracted FA assigned by an ATC clearance so discard
CFL_FA_DISCARD	459	448	465	456	484	511	DISCARD	FA notified beyond last conflict actual start time so discard
STD_FA	186	186	194	203	203	235	FA	Standard false alert
RETRACT_FA	193	169	206	195	238	272	FA	Retracted false alert, notification end time < predicted conflict start time

Table 4: IFA Trial Plan Runs Alert and Conflict Record Counts

Description	SCENARI0						
	1100_1600	1200_1700	1300_1800	1400_1900	1500_2000	1600_2100	Average
Total Alert Records	42026	41602	43298	41439	42410	45718	42749
Total Notification Sets	5912	6060	6364	6199	6300	6808	6274
Total Number of MAs	45	50	49	50	43	46	47
Total Number of FAs	379	355	400	398	441	507	413
Total Number of VAs	2193	2154	2245	2178	2152	2338	2210
Total Number of Discards	3351	3561	3722	3630	3704	3965	3656
Total Number of Encounters (not conflicts)	4403	4386	4639	4587	4686	5120	4637
Total Number of Conflicts (C)	2259	2225	2310	2248	2210	2401	2276
Missed Alert Probability = #MA/(#MA+#VA)	0.0201	0.0227	0.0214	0.0224	0.0196	0.0193	0.021

Table 5a: IFA Trial Plan Runs 1100_1600 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 8	1448	318	0.220
8 >= X < 11	327	10	0.031
11 >= X < 13	205	8	0.039
13 >= X < 19	776	17	0.022
19 >= X	1647	26	0.016
Subtotals	4403	379	

Table 5b: IFA Trial Plan Runs 1200_1700 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 8	1449	301	0.208
8 >= X < 11	323	8	0.025
11 >= X < 13	219	7	0.032
13 >= X < 19	761	9	0.012
19 >= X	1634	30	0.018
Subtotals	4386	355	

Table 5c: IFA Trial Plan Runs 1300_1800 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 8	1575	343	0.218
8 >= X < 11	359	10	0.028
11 >= X < 13	226	5	0.022
13 >= X < 19	789	9	0.011
19 >= X	1690	33	0.020
Subtotals	4639	400	

Table 5d: IFA Trial Plan Runs 1400_1900 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 8	1630	349	0.214
8 >= X < 11	346	9	0.026
11 >= X < 13	211	5	0.024
13 >= X < 19	783	10	0.013
19 >= X	1617	25	0.015
Subtotals	4587	398	

Table 5e: IFA Trial Plan Runs 1500_2000 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 8	1629	382	0.234
8 >= X < 11	374	17	0.045
11 >= X < 13	239	4	0.017
13 >= X < 19	792	16	0.020
19 >= X	1652	22	0.013
Subtotals	4686	441	

Table 5f: IFA Trial Plan Runs 1600_2100 Study False Alert Probabilities

FA Bin	#Encounters	#FAs	Prob(FA)
0 >= X < 8	1756	432	0.246
8 >= X < 11	442	19	0.043
11 >= X < 13	255	7	0.027
13 >= X < 19	889	14	0.016
19 >= X	1778	35	0.020
Subtotals	5120	507	

Table 5g: IFA Trial Plan Runs Average Study False Alert Probabilities
(i.e. CIA1068 - CIA1072)

FA Bin	Prob(FA)
0 >= X < 8	0.223
8 >= X < 11	0.033
11 >= X < 13	0.027
13 >= X < 19	0.016
19 >= X	0.017

Table 6: IFA Trial Plan Runs Aircraft to Airspace Conflict Prediction Accuracy Counts

Code	1100_1600	1200_1700	1300_1800	1400_1900	1500_2000	1600_2100	Alert Type	Reason Description
STD_VA	2013	1966	2053	1969	1966	2147	VA	Standard valid alert
LATE_VA	180	188	192	209	186	191	VA	Late valid alert, valid since conflict was a popup
NO_CALL_MA	34	42	36	39	28	32	MA	No call missed alert
LATE_MA	11	8	13	11	15	14	MA	Late missed alert
NO_CALL_DISCARD	19	17	15	17	12	15	DISCARD	No call discarded since out of adherence
LATE_DISCARD	2	4	1	3	3	2	DISCARD	Late discard since out of adherence
NO_TRK_FA_DISCARD	2564	2764	2900	2800	2834	3035	DISCARD	No post processed track a predicted conflict start time so discard
NO_ADHER_FA_DISCARD	153	166	173	210	223	251	DISCARD	Out of adherence at predicted conflict start time so discard
CLR_FA_DISCARD	154	162	168	144	148	151	DISCARD	Retracted FA assigned by an ATC clearance so discard
CFL_FA_DISCARD	459	448	465	456	484	511	DISCARD	FA notified beyond last conflict actual start time so discard
STD_FA	186	186	194	203	203	235	FA	Standard false alert
RETRACT_FA	193	169	206	195	238	272	FA	Retracted false alert, notification end time < predicted conflict start time

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[3] Accuracy working group list includes all participants involved on URET CCLD accuracy measurement. Email sent to the ACT-250 email account, accuracy@tatca.tc.faa.gov, will be forwarded to everyone in the list.